

# INTRODUCTION

This report is the second of two publications containing results from the 2000 Survey of Industrial Research and Development. The first publication, an InfoBrief<sup>1</sup> announcing the availability of survey results, contains analytical information and highlights the increase in industrial research and development (R&D) funded from companies' own resources and the sales and employment reported by R&D-performing firms. This report contains, in section A, the full set of statistics produced from the survey including statistics on R&D funding during the calendar year 2000 and on R&D personnel in January 2001. Among the tables are several that include statistics on trends in industrial R&D since 1953, statistics on employment by R&D-performing firms since 1989, and a table classified by state that contains statistics for selected years since 1981. This report also contains (in the technical notes in section B) information about the new industry coding classification system and expanded company size classifications, both implemented for the 1999 survey,<sup>2</sup> survey methodology, comparability of the statistics over time, survey definitions, history of the survey, and other information designed to convey to the data user what the survey statistics represent and, in some cases more importantly, what they do not represent. Survey forms, instructions, and other documents are reproduced in section C.

This report provides national estimates of the expenditures on R&D performed within the United States by industrial firms, whether U.S. or foreign owned. Among the statistics are estimates of total R&D, the portion of the total financed by the Federal Government, and the portion financed by the companies themselves or by other non-Federal sources such as state and local governments or other industrial firms under contract or subcontract. Total R&D is also separated into the types of costs (wages, materials and supplies, depreciation, and other costs). Other statistics include R&D financed by a domestic firm but performed outside the United States, R&D contracted to organizations outside of the firm, and the funds spent to perform energy-related R&D. Also, this report provides information on R&D-performing firms including domestic net sales, number of employees, number of R&D-performing scientists and engineers,

geographic location of where the R&D was performed, and R&D funds spent per R&D-performing scientist and engineer.

The National Science Foundation Act of 1950, as amended, authorizes and directs the National Science Foundation (NSF) "...to provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources, and to provide a source of information for policy formulation by other agencies of the Federal Government." The Survey of Industrial Research and Development is the vehicle with which NSF carries out the industrial portion of this mandate and NSF's Division of Science Resources Statistics has sponsored and managed a survey of industrial R&D since 1953. The 1953–56 surveys were conducted by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor.<sup>3</sup> Since 1957, the Bureau of the Census in the U.S. Department of Commerce has conducted the survey.<sup>4</sup> Census staff conduct the survey under Title 13 of the United States Code, which prohibits publication or release of data or statistics that may reveal information about individual companies.<sup>5</sup>

The Survey of Industrial Research and Development is an annual sample survey that intends to include or represent all for-profit R&D-performing companies, either publicly or privately held. Respondents receive detailed definitions to help them determine which expenses to include or exclude from the R&D data they provide. Nevertheless, the statistics presented in this report are subject to response and concept errors caused by differences in the way respondents interpret the definitions of R&D activities and by variations in company accounting procedures. The survey's primary focus is on U.S. industry as a performer of, rather than as a source of funds for, R&D. Thus, data on Federal support of R&D activities performed by industry are collected, and the resulting statistics appear in several tables while statistics on industrial funding of R&D undertaken at universities and colleges and other nonprofit organizations are not

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<sup>1</sup>See NSF (2002a).

<sup>2</sup>See NSF (2001).

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<sup>3</sup>See NSF (1956) and NSF (1960).

<sup>4</sup>Data obtained in the earlier BLS surveys are not directly comparable with Census figures because of methodological and other differences.

<sup>5</sup>In some tables in this report, the symbol "(D)" is used to indicate that estimates were withheld to avoid possible disclosure of information about operations of individual companies.

collected or included.<sup>6</sup> The result of collecting and publishing performer-reported statistics is that the federally funded R&D performance totals presented in this report differ from the totals reported by the Federal agencies that provide the funds and the statistics published in NSF's *Federal Funds for Research and Development* report series. One reason for these differences is that performers of R&D often expend Federal funds in a year other than the one in which the Federal Government provides authorization, obligations, or outlays.<sup>7</sup> During the past several years, the differences have widened between the Federal R&D funding reported by performers and that reported by funding agencies. These differences are documented and analyzed in the latest editions of NSF's *Science & Engineering Indicators* (<http://www.nsf.gov/sbe/srs/seind/start.htm>) and *National Patterns of R&D Resources* (<http://www.nsf.gov/sbe/srs/nprdr/start.htm>) report series.

The content of the Survey of Industrial Research and Development has been expanded and refined over the years in response to an increasing need by policymakers for more detailed information on the nation's R&D effort. For example, questions on energy R&D were added in the early 1970s, following the oil shortage crisis. On the other hand, collection of certain data items has been eliminated in recent years in an attempt to alleviate some of the burden on respondents. For large firms known to perform R&D, a detailed survey form (Form RD-1) is used to collect data. To limit the reporting burden on small R&D performers and on firms included in the sample for the first time, an abbreviated survey form (Form RD-1A), which collects only the most crucial data, is used.

Several changes have been made to the survey since the early 1990s that are of special importance to users of this report. Prior to the 1992 survey, statistics were based on samples selected at irregular intervals (i.e., 1967, 1971, 1976, 1981, and 1987). In intervening years, a subset of the last sample, a panel, was used. For example, original estimates for 1988–91 were based on surveys of approximately 1,700 panel companies that reported R&D activity in the 1987 survey. Beginning with the 1992

survey, statistics are based on samples selected annually. Also beginning with the 1992 survey, the sample size was increased from approximately 14,000 to approximately 25,000 firms. Annual sampling and the increase in sample size were instituted for several reasons: (1) to account better for births of R&D-performing establishments in the survey universe; (2) to survey more fully and accurately R&D performed by nonmanufacturing firms, especially in the service sector; and (3) to gather more current information about potential R&D performers.

Prior to the 1994 survey cycle, all companies that spent more than \$1 million annually on R&D in the United States or had 1,000 or more employees received a survey form every year. Beginning with the 1994 cycle, the employee cutoff was dropped from the criteria and, beginning with the 1996 cycle, the R&D level was raised to \$5 million, where it has remained for subsequent surveys.<sup>8</sup> For all cycles of the survey, the remaining firms (i.e., those that were not considered “certainties” because of the selection criteria) were subjected to probability sampling and may or may not receive a survey form for a given year. Among the organizations purposely excluded from the survey were trade associations and not-for-profit industrial consortia. Although their primary mission is to serve industry, these associations were excluded because they are nonprofit organizations.

Industry statistics in this report were developed from data collected from individual companies.<sup>9</sup> Since the survey is company-based rather than establishment-based, all data collected for the various components of each company (plants, divisions, or subdivisions) were tabulated in the company's major industrial classification which was based on payroll.<sup>10</sup> The resulting industry estimates were estimated by summing the data for companies classified within each major industry classification. National totals were then estimated by summing the industry estimates. Beginning with the 1999 survey, a company's major industrial classification was determined and the resulting

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<sup>6</sup>Data on R&D performed at universities and colleges are collected in the annual Survey of Research and Development Expenditures at Universities and Colleges. More information about this survey is available from NSF's Division of Science Resources Statistics website at <http://www.nsf.gov/sbe/srs/rdexp/start.htm>.

<sup>7</sup>See “Comparisons to Other Statistical Series” in section B for definitions of these terms.

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<sup>8</sup>See “Identifying Certainty Companies” in section B for more information about the employee cutoff and certainty threshold.

<sup>9</sup>In the Survey of Industrial Research and Development and in the publications presenting statistics resulting from the survey, the terms “firm,” “company,” and “enterprise” are used interchangeably. “Industry” refers to the 2-, 3-, or 4-digit North American Industrial Classification System (NAICS) codes or group of NAICS codes used to publish statistics resulting from the survey.

<sup>10</sup>See “Frame Creation” in section B for more information about industry classification.

industry statistics are published using the North American Industrial Classification System (NAICS). For prior years, the Standard Industrial Classification (SIC) system was used. The development and on-going refinement of NAICS has been a joint effort of statistical agencies in Canada, Mexico, and the United States. The system replaced the Standard Industrial Classification (1980) of Canada, the Mexican Classification of Activities and Products (1994), and Standard Industrial Classification (1987) of the United States.<sup>11</sup> NAICS was designed to provide a production-oriented system under which economic units with similar production processes are classified in the same industry. NAICS was developed with special attention to classifications for new and emerging industries, service industries, and industries that produce advanced technologies. NAICS not only will facilitate comparability of information about the economies of the three North American countries, but potentially will increase comparability with the two-digit level of the United Nations' International Standard Industrial Classification (ISIC) system.

Important for the Survey of Industrial Research and Development are several of the new classifications that cover major performers of R&D in the U.S. Among manufacturers, the computer and electronic products classification (NAICS 334) includes makers of computers and peripherals, semiconductors, and navigational and electromedical instruments. Among nonmanufacturing industries are information (NAICS 51) and professional, scientific, and technical services (NAICS 54). Information includes publishing, both paper and electronic; broadcasting; and telecommunications. Professional, scientific, and technical services includes a variety of industries. Of specific importance for the survey are those that provide engineering and scientific R&D services.

The change of industry classification system affects most of the statistical tables produced from the survey. Prior to the 1999 report, tables classified by industry contained the current survey's statistics plus statistics for ten previous years. Because of the new classification system, these tables now contain only statistics for the current year (2000) and one prior year (1999). However, to provide a bridge for users who want to make year-to-year comparisons below the aggregate level, in several tables statistics from the 1997 and 1998 cycles of the

survey, which were previously classified and published using the SIC system, have been reclassified using the new NAICS codes. These reclassified statistics are slotted using their new NAICS classifications alongside the 1999 and 2000 statistics, which were estimated using NAICS from the outset.

Another enhancement that was implemented for the 1999 cycle of the survey was an increase in the number of company size categories used to classify survey statistics. The original 6 categories have been expanded to 10 to emphasize the role of small companies in R&D performance and to highlight the growth in the amount of R&D performed by smaller companies compared to the amount performed by larger companies. The more detailed business size information also facilitates better international comparisons. Generally, statistics produced by foreign countries that measure their industrial R&D enterprise are reported with more detailed company size classifications at the lower end of the scale than U.S. industrial R&D statistics historically have been.<sup>12</sup> The more detailed classifications of the U.S. statistics will enable direct comparisons with other countries' statistics.

NSF's objective in conducting the survey has always been to provide estimates for the entire population of firms performing R&D in the United States and to present the estimates in as many meaningful ways as possible. This is especially true for the character of work components of R&D, basic research, applied research, and development. Since the beginning of the survey, NSF has attempted to estimate each component, relying on traditionally poorly reported data. The methods NSF has used to develop these estimates are discussed in section B. It is important for the user of this report to know that a review has been made of the underlying data used to prepare recent estimates of basic research, applied research, and development and, as a result of the review, the on-going effort to strengthen and maintain the quality of character of work estimates has intensified. Identification of anomalous reporting patterns is underway and research is being pursued to determine appropriate methods of dealing with the anomalies. Publication of character of work distributions of R&D has been suspended until the research is complete and recommendations have been made.

<sup>11</sup>For a detailed comparison of NAICS to the Standard Industrial Classification (1987) of the United States, visit <http://www.census.gov/epcd/www/naics.html>.

<sup>12</sup>For more information, visit the Organisation for Economic Co-operation and Development (OECD) website at <http://www.oecd.org>.

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